

## Letters to the Editor – Reply to Jungbluth & Demmeler \*

### The Ecology of Scale

#### Assessment of Regional Energy Turnover and Comparison with Global Food

Elmar Schlich

Justus-Liebig-University Gießen, Department of Home Engineering, Stephanstr. 24, 35390 Gießen, Germany  
([Elmar.Schlich@ernaehrung.uni-giessen.de](mailto:Elmar.Schlich@ernaehrung.uni-giessen.de))

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The Letter to the Editor of Jungbluth and Demmeler (DOI: <http://dx.doi.org/10.1065/lca2004.11.191>, this issue, pp. 168–170) does not cast any doubt on the major conclusions of the article attacked. First and foremost, we conclude that regional production is not automatically associated with a lower turnover of energy, compared with global food; second, our findings point upon a digressive function of specific energy turnover ( $y$ ) and business size ( $\log x$ ), which we call 'The Ecology of Scale'  $y = f(\log x)$ . Further examples of that function are presented in the online conference in LCA/LCM 2004 (Schlich 2004).

The objective of our research was to verify or to falsify the hypothesis that the scale does have an influence upon the energy efficiency of food production and distribution, both regionally and globally. Hence, we had to investigate and to compare units of different size at different places of primary production.

We named that digressive function 'Ecology of Scale', because a similar function called 'Economy of Scale' is very well known in economics. Here, the cost per piece is determined by the number of produced items, as described by a digressive function. It includes the definition of a break-even number of items, defining a competitive production. Although economy involves much more than cost per piece, the term 'Economy of Scale' is accepted by the scientific community. Energy is one of the most important parameters of ecology. Knowing the direct energy intake of each step of an investigated process chain, we can and we calculated the primary energy turnover and the carbon dioxide release as important ecological impacts.

By knowledge of this function, a minimum business size (break-even) for the production of the specific food (juices, lamb meat) could be identified. Quite important is the fact that both the juice and the lamb meat samples can be presented as regional business units, which are able to compete with global food in terms of energy, because of their sufficient size. Finally, our article declares all findings as valid for the investigated food items alone. This corresponds with good scientific practice, because a **qualitative** scientific method is performed.

The Letter to the Editor focuses on two major objections. First, it complains about the lacking representativity of our investigation, and secondly, it presents supposed errors of a referred source (Fleissner 2001).

As was very clearly noted in our publication, we performed a **qualitative** investigation (synonym: case study), by means of our own empirical research. The scientific term of 'representativity' is applied in case of **quantitative** investigations alone. In science, the terms of quantitative methodology are obviously not suitable to devaluate qualitative scientific investigations.

In the event that a German consumer association would like to perform scientific research on the production and distribution of potatoes, it would be valid to use a qualitative method with only **one** example. And supposing, as well that the investigated farm contracts only involve **one** retailer of all the produced potatoes within a distance of 5 km, this **one and only** investigated example indicates a high efficiency of this process chain (Burdick 2004).

This result may be scientifically correct, but it is impossible to serve 82.5 million German people, living in one of the most crowded countries of the world, as the one potato farmer with the one retailer is able to do. It is in science neither usual nor useful, to evaluate qualitative findings by quantitative tools. It might be nice to show a combination of qualitative findings and statistical data in Fig. 1, but it leads to some scientific confusion.

The referred dissertation (by the way: at Justus-Liebig-University Gießen, this is by far not equal to a Ph.D. thesis!) is the final report of scientific research that was performed at our department from 1997 to 2001. Obviously, the present article and the dissertation cited are not identical, because it is not just an extract of the dissertation. Otherwise, we could have already published this article in 2001. In the years from 2001 to 2003, we did not sleep, but even investigated more examples and validated the former data.

Nevertheless, I will respond to the objections in detail. In fact, our investigation of energy balances and the allocation of these data to functional units meet all the requirements of LCA-methodology. We did not just add litres of gas and kWh (this is not possible in physics, because of differing units). We calculated the primary energy turnover and the carbon dioxide release as well, including the question of a differing electrical energy mix in Germany, Brazil and New Zealand, causing a different, specific carbon dioxide release.

Pesticides, etc. are not included. But it should not be the 'black or white' question, if any farmer – either regional or global – is using plant protection measures, to be answered by a simple

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yes or no! Much more interesting would be the question of allocation of these measures to the functional units, comparing business units of a different scale from different parts of the world. I would be very curious about unexpected results of small-scale farming compared with global food.

The process chains of any food – either regional or global – re-tailed in Germany are supervised very intensively. The farmers are contracted to GMP<sup>1</sup> and use precision farming when applying plant protection measures. All food meets the legal requirements of HACCP<sup>2</sup>, including all national and international food laws and standards (e.g. BRC, IFS, EUREPGAP<sup>3</sup>). The Brazilian farmers of the visited farms are used to ISIP and GIS<sup>4</sup> in the orange production. Otherwise they would not get a contract to German diluting companies.

Because of their responsibility by law, the food producers and retailers in Germany sign contracts with high standard specifications, performing analytical investigations of residues in the food. Even the quality of the ground water or the soil at the place of production is analysed, by means of unexpected sampling at any regional or global place of farming.

In New Zealand, no doping of the sheep is used, almost no medicine and no drugs, even no feed except the grass. In Germany, most farmers apply power feed to the sheep in the wintertime. Some years ago, many European farmers even used feed made from slaughter residues, causing scrapie in the sheep and BSE in the cattle.

The system boundaries of our study are clearly remarked, as is demanded in LCA standards. We included the yearly energy which is used for all the related farming, breed, crop and irrigation, all machining on the farm, all transports inside and outside the farm, all transports up to the food processing units and all efforts for the distribution up to the point of sale.

The system boundary is not the household! In case of squeezing facilities of each size, the transport of the fruit crop is included, performed by private land owners, farmers or contracted companies. The return journey of these cars, tractors or trucks is sometimes used to transport juice bottles, and sometimes not. In terms of energy, it almost doesn't matter if the crop delivering cars, tractors and trucks go back empty or loaded with juice. These cars, tractors and trucks have to go back anyway, because they don't remain forever at the squeezing facility. Hence, it is absolutely necessary and correct to take these energy efforts into account.

Room heating had to be included in the calculation of one squeezing facility, because there indeed was a room heating, which needed energy for that purpose, for a limited area of the total plant and for a limited time of the year. The allocation of that effort was easy, because we could identify the heated area and time.

<sup>1</sup> GMP: Good Manufacturing Practice.

<sup>2</sup> HACCP: Hazard Analysis and Critical Control Points.

<sup>3</sup> BRC: British Retail Corporation. IFS: International Food Standard. EUREPGAP: Euro Retailer Produce Working Group; Good Agricultural Practice.

<sup>4</sup> ISIP: Information System Integrated Plant Production; GIS: Geographic Information System, based on GPS.

The transport distance from the harbour to the consumer is not assessed as 400 km. This is a severe misunderstanding. The distance of 400 km cited is only the one-way-distance, to transport the OJC<sup>5</sup> from the European harbours to the diluting company. The trucks are going back empty to the OJC-terminal at the harbours, because there is unfortunately no load for that type of truck. Again, all these efforts were taken into account and allocated to the functional unit.

Finally, the energy intake of the distribution – that term means all the transports of the juice from the juice production plant to the points of sale throughout Germany (including Munich, of course!) was measured by means of all data of the internal and external trucks. The return of the empty bottles, including washing the bottles before refilling, was taken into that allocation as well.

We did not investigate directly produced juice. At the time of that part of our research, there was only one company which sold directly produced orange juice in Germany. This directly produced juice was additionally labelled as 'organic' food. Most remarkably is the fact that an 'organic' company rejected our request for confidential cooperation, transfer of data and evaluation of the process chain, although the company claimed, in public, to save energy by producing juice without any concentration!

Finally, the Letter to the Editor complained the lacking reflection of former papers. The objective of our article was to present the scientific method that we used and the qualitative data that we researched. It was not our objective to give an entire overview about the state of the art.

To sum up, I can say that our article presents valid data which we obtained by qualitative research worldwide. Regarding the investigated food samples, our findings point at a digressive dependence of the specific energy turnover on the business size. We found regional process chains which are able to compete in terms of energy with global food, due to their sufficient size. On the other hand, regional production is not automatically associated with a lower turnover of energy, compared with global food.

Our investigation leads to a minimum-business size which can easily be obtained by the cooperation of small-scale local farmers. In both cases – juice and lamb meat – our study reports on local or regional examples of that competitive cooperation. So we have an instrument for political advice as well, valid for the investigated food. The public debate on this issue promotes the necessary discourse in an industrial country like Germany which depends on food import to a large extent.

## References

- Burdick B (2004): Personal presentation at the Kassel meeting, 2004-07-19, in the presence of Demmeler, Heißenhuber, Gensch et al.
- Fleissner U (2001): Energetische Bewertung der Bereitstellung ausgewählter regionaler und überregionaler Lebensmittel. Dissertation an der Justus-Liebig-Universität Gießen. Aachen, Shaker
- Schlich E, Schlich M (2004): The Ecology of Scale. Further Examples and Comments. International Conference of Life Cycle Assessment – Life Cycle Management 2004 (online) <<http://www.lcacenter.org/InLCA2004/>>

<sup>5</sup> OJC: Orange Juice Concentrate.